An Assessment of the Dietary Preferences in Two Species of Coastal Stingrays from The Bahamas

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INTRODUCTION

Stingrays evolved over 450 million years ago during the late Silurian era, and were among the first jawed vertebrates (Last and Stevens 2009; O'Shea 2013). Since then, they have radiated to occupy ever major aquatic bioregion on earth (O'Shea 2013). Additionally, rays are critical components to the overall function and health of coastal and nearshore ecosystems (O'Shea et al. 2012). Batoids represent a significant portion of fish biomass in tropical coastal environments and typically characterize marine near shore habitats. By their very nature, coastal environments face continued extrinsic pressures on account of being the interface between terrestrial and marine environments. This is largely due to habitat degradation caused by overfishing, pollution, climate change and urbanization (Crain et al. 2009). Due to this it has never been more relevant to establish baselines for the conservation and management of these vulnerable habitats.

In the coastal habitats of Cape Eleuthera, this study involved two species of stingray (Dasyatidae); the southern stingray (*Dasyatis americana*) and the Caribbean whiptail (*Styracura schmardae*). These two species are classified as data deficient by the IUCN Red List, and this deficiency affects not only the conservation of these species but the habitats that support them. These two large bodied stingrays coexist in the same environments, yet it is unclear as to how they partition common resources in order to coexist without competition. This study will address these gaps in our understanding of resource partitioning between these two species.

Figure 1a: A southern stingray occupying the shallow warm waters of the Schooner Cays, south Eleuthera.

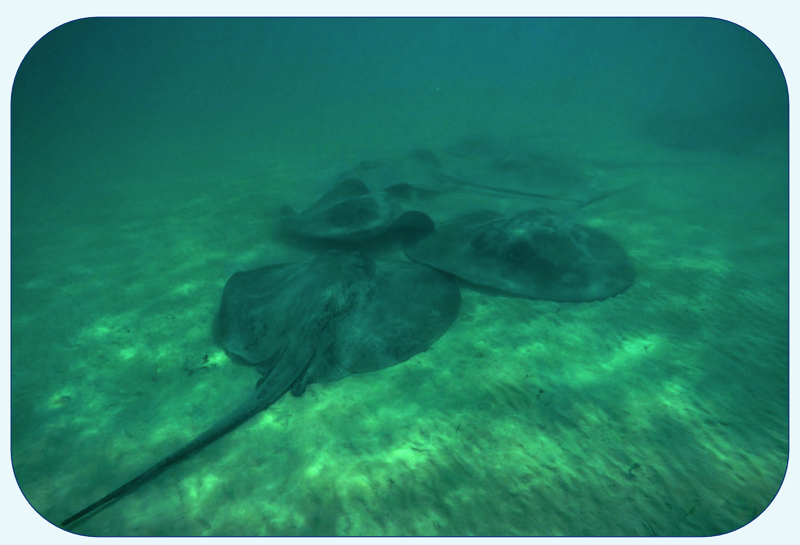

Figure 1b: Caribbean whiptail rays aggregating at Hummingbird Cay near to great Exuma Island.

OBJECTIVES

1. Describe the dietary composition of southern stingrays (*Dasyatis americana*) and Caribbean whiptail rays (*Styracura schmardae*) in South Eleuthera.
2. Compare the diets between southern stingrays (*Dasyatis americana*) and Caribbean whiptail rays (*Styracura schmardae*) to assess discrepancies in foraging strategy and preference.

MATERIALS AND METHODS

1. Spot seining is used to catch stingrays. The ray is encircled and herded into a 10m seine net and then captured with a dip net (Figure 2a).
2. Morphometric measurements are taken to access physical fitness and ontogenetic stage.
3. Gastric lavage is performed by inserting a silicone tube into the buccal cavity, down the esophagus and into the stomach. Three 60 ml portions of salt water are introduced which induces regurgitation.
4. Biomass is collected on a porous container fitted with a 1mm mesh net.
5. Samples are taken back to the CEI wet lab facilities and are sorted with a three layer sieve stack before being identified to the highest taxonomic resolution.

Figure 2a: A successful capture of a stingray with a constricted circle

Figure 2b: A student analyzes the stomach contents of a stingray

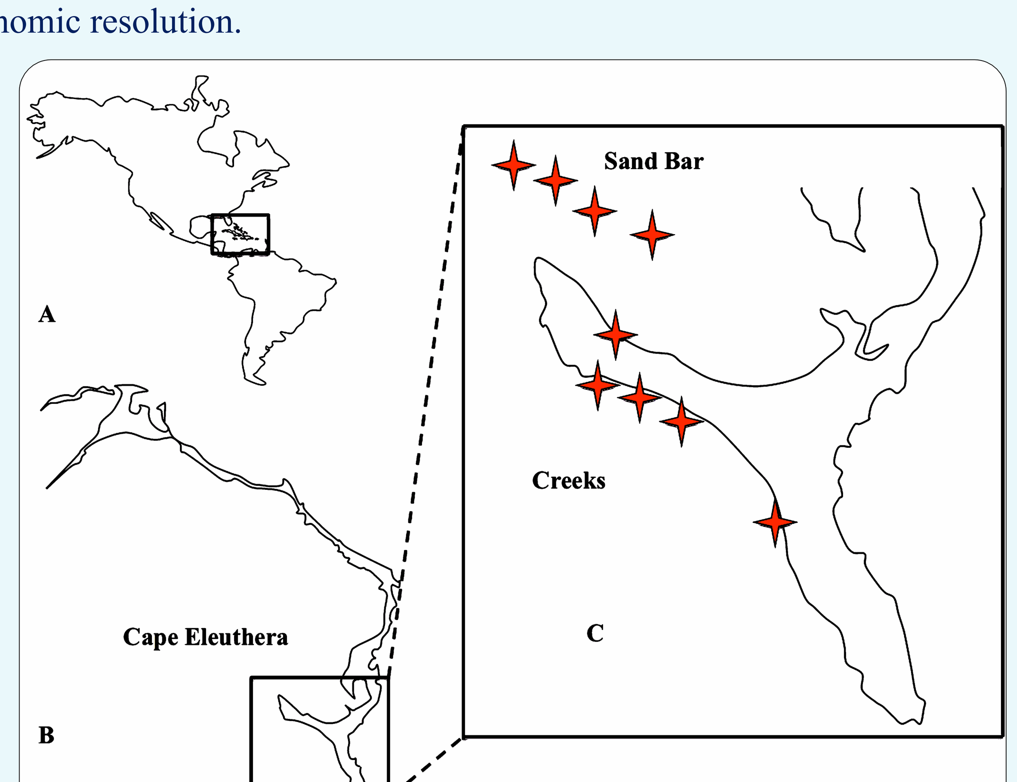

Figure 2c: A map of various locations of capture around Cape Eleuthera, The Bahamas

RESULTS

In total, 31 stingray stomachs were assessed between September and November 2016 (*Dasyatis americana* n=21; *Styracura schmardae* n=10). Of theses, 43% of *D. americana* and 30% *S. schmardae* stomachs were empty. The disc widths measured ranged between 460-952 mm for *D. americana* and 434-628 mm for *S. schmardae*. These ranges suggest a large ontogenetic spread for southern stingrays, however a potential bias towards juvenile Caribbean whiptails.

Table I: The index of relative importance (%IRI) for each of the prey groups in *S. schmardae* and the *D. americana* diets.

	Dasyatis americana			*Styracura schmardae*		
	Teleostei	Crustacea	Annelida	Teleostei	Crustacea	Annelida
%F	22.73	54.55	4.55	0	60	30
%N	17.65	79.41	2.94	0	74	26
%M	11.05	88.93	0.02	0	91.43	11.68
%IRI	6.52	91.82	0.13	0	99.25	11.3

Snapping shrimp (*Alpheus* spp.) were the most abundant prey type (Figure. 3), however when looking specifically at the diet for each species, it made a much larger component of *S. schmardae*'s rank abundance (2nd) than it did for *D. americana* (4th). Crustaceans dominated the diets of the two species representing over 90% IRI for both. Additionally, annelids were found not to be a prevalent prey type, having a %IRI of 0.1 for *D. americana* and 11.3 for *S. schmardae*. Teleostei made up 6.5% IRI of the diet of *D. americana*, yet were found to be absent in the diet of the *S. schmardae.* Fifty percent of the prey types were represented in the diet of *S. schmardae* showing that *D. americana* has twice the dietary diversity as *S. schmardae*.

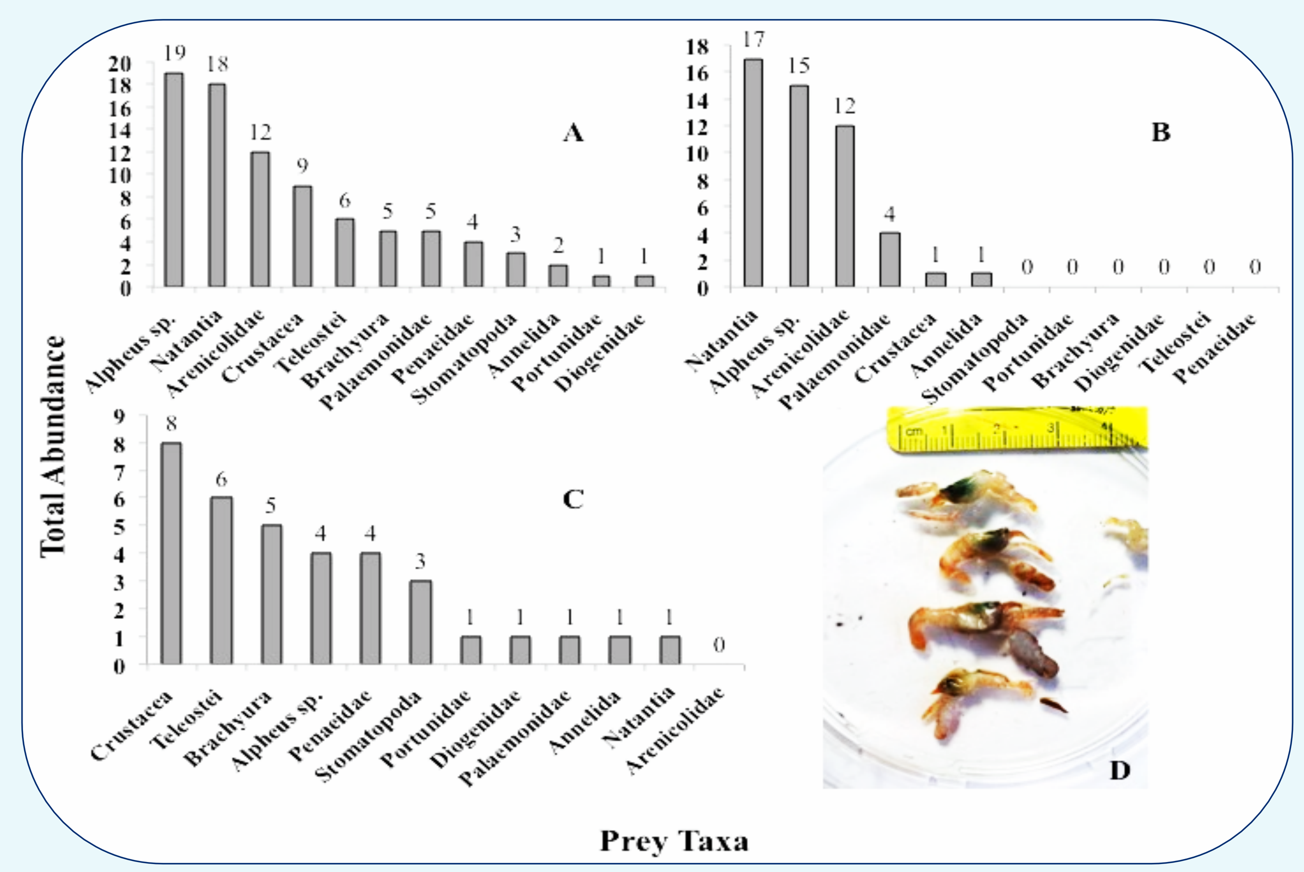

Figure 3: The rank abundance of prey taxa found in the stomachs of a) all species pooled b) *S. schmardae* c) *D. americana*. d) *Alpheus* sp. is a major prey type found in both species but primarily in *S. schmardae*.

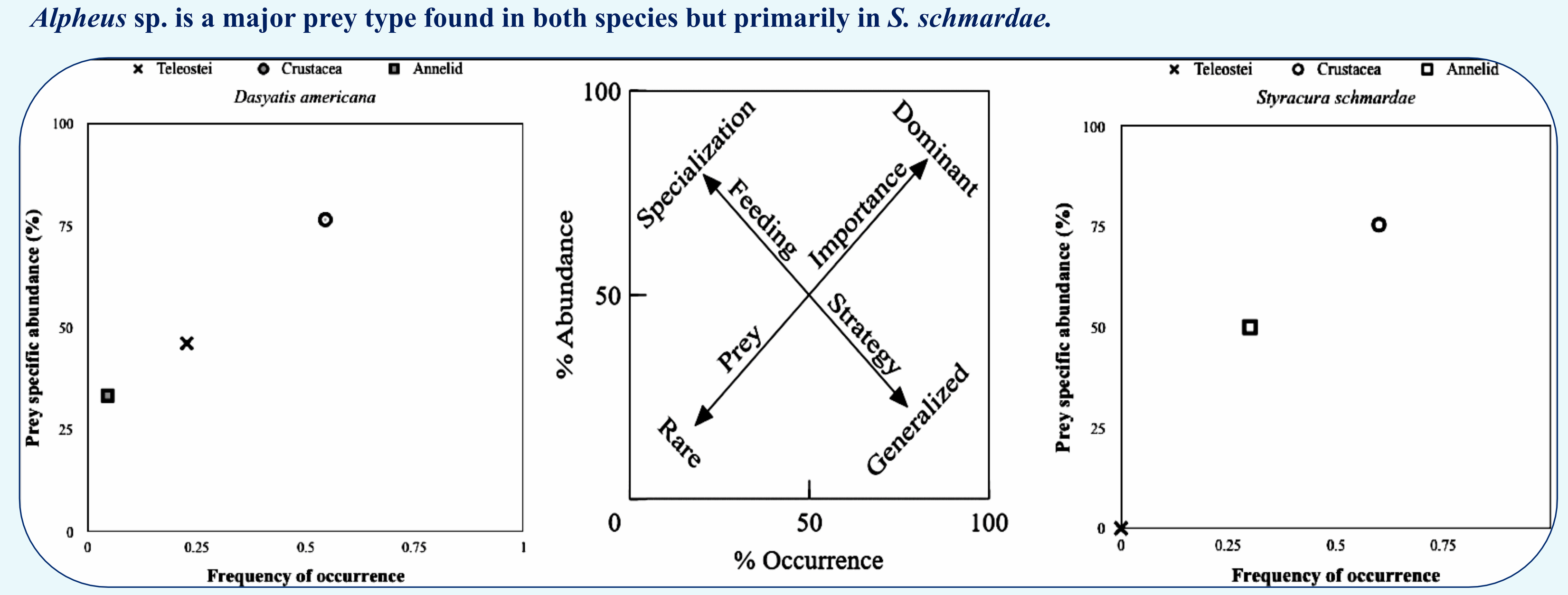

Figure 4: A) Foraging strategy plot for *D. americana.* B) The Costello method (*Amundsen, 1996*), which demonstrates the feeding strategies employed on each respective prey type based on a data point's position. C) Foraging strategy plot for *S. schmardae*.

Foraging strategy analyses (after Amundsen, 1996), showed that both species employed specialized and dominant feeding strategies on crustaceans and a more generalized and rare predation strategy on teleosts and annelid worms which are considered rare prey types (Fig. 4b). However, the position of teleosts and annelid worms in terms of dominance had an inverse relationship between the two species (Fig. 4a and c).

DISCUSSION

The diet of *D. americana* correlates closely to that of its sympatric counterpart, *S. Schmardae*. Annelida represented 11.3% of the assessed *S. schmardae* diet, while crustaceans constitute 99.3% and Teleostei 0%. Due to the overwhelming comparative similarities between the diets, these results indicate that a prevention of competitive exclusion through dietary partitioning between these sympatric species is not present. Rather, we can infer possible small scale spatial or temporal partitioning between the species which permits high levels of dietary similarity conducive with sympatry. Largely, this data functions to minimize the data deficiency in these believed to be keystone species, and augments our understanding of their trophic positioning and positionality within the marine food web, elements crucial to the effectiveness of conservation efforts (O'Shea et al 2012).

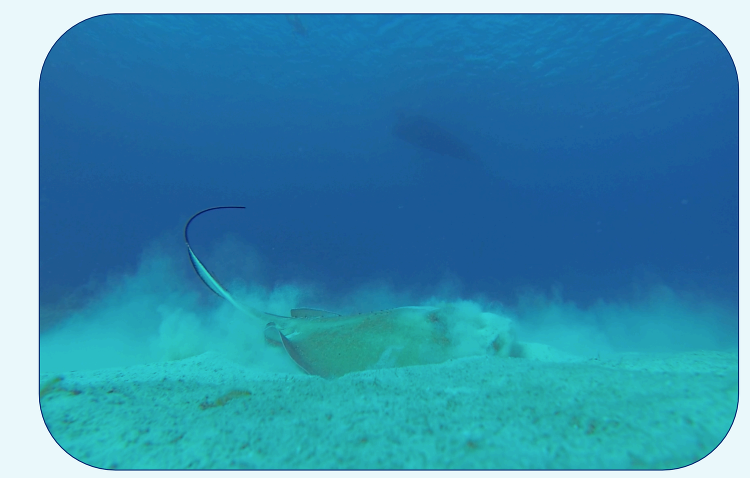

Figure 5a: A southern stingray bioturbating to access infaunal prey concealed beneath the sediment.

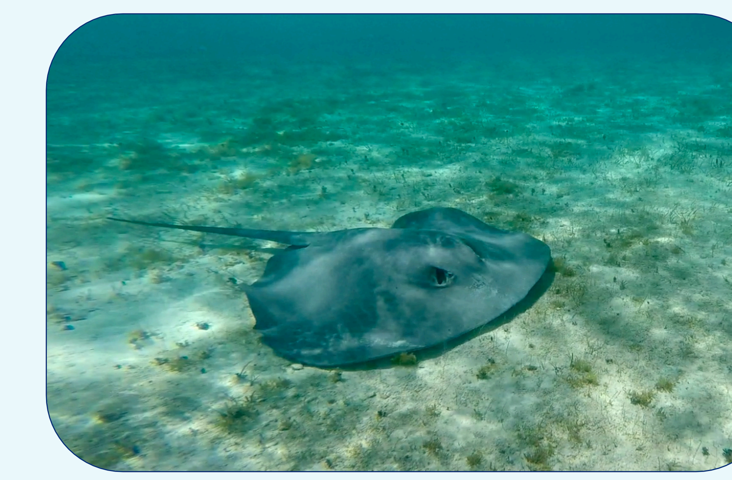

Figure 5b: A Caribbean whiptail ray exhibiting its demersal nature

CONCLUSION

In our study we found that crustaceans dominated over 90% IRI of the diets of *D. americana* and *S. schmardae*. Additionally, the diet of *D. americana* was twice as diverse as the diet of *S. schmardae*. These results indicate that small scale spatial partitioning is potentially occurring in costal Bahamian waters between these two species.

FUTURE DIRECTIONS

1. **Expansion of sample size:** the sample size was not large enough to produce an asymptote on a randomised prey accumulation curve.
2. **Employment of alternative dietary analysis strategies:** hard bodied crustaceans may resist digestion longer than soft-bodied prey types (e.g. annelids).
3. **Assessment of mature *S. schmardae*:** Traveling to different locations for the assessment of mature individuals of *S. schmardae.*
4. **Assessment of prey abundance:** Core samples taken in the locations of capture could possibly explain why crustaceans dominate both diets.

Figure 6a: A group of student researchers taking morphometric measurements post-capture.

Figure 6b: A Caribbean whiptail ray caught in a dip net

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